Public Utilities Office

Market Design and Operation Working Group - Meeting 1

DATE/TIME: **12 March 2019 – 9:30am to 1pm**

LOCATION: **Level 45, 152 St Georges Terrace, Perth**

Item no.	Agenda Item	By Whom	Time
ITEMS FOR DISCUSSION			
1.	**Introduction**	Chair	5 mins
2.	**Tranche 1 Consideration for the participation of Energy Storage Systems in the WEM**	AEMO (with support from Western Power)	40 mins
3.	**Energy Scheduling and Dispatch**	Consultants	2.5 hours

Government of **Western Australia**
Department of **Treasury**

Market Design and Operations Working Group

Meeting 2: 12 March 2019

AGENDA ITEM 1

INTRODUCTION

CHAIR

GROUND RULES

- There is a large amount of material to work through in the workshop today, and the session chair will try to keep us on time in order to have sufficient time for discussion

- Should it not be possible to get through all the material within the available workshop time, a second session may be scheduled depending on the amount of material remaining and availability of attendees, or alternatively feedback may be provided out of session

- We will attempt to capture all questions/answers discussed during the session today, for circulation after the workshop along with these slides

- Consultation papers are planned to be released following discussion process at working group meetings seeking industry feedback

- All feedback/discussion is relevant, if attendees do not have a chance to ask a question or raise an issue, please feel free to contact marketdesign.wg@treasury.wa.gov.au

AGENDA ITEM 2

TRANCHE 1 CONSIDERATION FOR THE PARTICIPATION OF ENERGY STORAGE SYSTEMS IN THE WEM

AEMO (WITH SUPPORT FROM WESTERN POWER)

Government of **Western Australia**
Department of **Treasury**

WEM Reform: Tranche 1 Consideration for the participation of Energy Storage Systems in the WEM

MDOWG – Meeting 2

12 March 2019

OBJECTIVE AND PROCESS

- As part of the WEM Reform Program one of the core reform packages is to review and consider changes to the WEM Rules framework to support the registration and participation of utility scale storage facilities.

- To deliver these objectives the Storage participation project has been devolved into two stages:
  - **Tranche 1** – Consider pathways for the connection and participation of energy storage systems (ESS) in as many markets as possible. The intention is to consider workable options requiring minimal changes to the WEM Rules, market systems and processes.

  - **Tranche 2** To deliver a pathway for all relevant technologies, including storage, to connect and participate in all relevant markets and mechanisms (i.e. energy, Ancillary Services and the Reserve Capacity Mechanism). To be implemented and operational by 1 October 2022.

BACKGROUND AND PURPOSE

- At present, there are no ESS registered as Facilities in the Wholesale Electricity Market (WEM) and there is a perception that the existing WEM Rules do not support the registration and participation of ESS.
- There is no specific Facility Class currently in the WEM Rules for an ESS.
- However, the PUO and AEMO consider some existing Facility Registration/Classes could enable an ESS to register in the interim.
- The PUO and AEMO have investigated these Facility Classes, considering the potential markets and mechanisms ESS may participate in.
- The purpose of today's MDOWG is to initiate discussions with stakeholders to inform them of work undertaken to-date to determine potential arrangements as part of Tranche 1.

TRANCHE 1 ASSESSMENT

- The Tranche 1 solution options assessed regulatory, technical, operational and implementation considerations.

- Options were considered viable if they:
  - Enabled ESS proponents to participate in the WEM in the immediate term; required only minimal changes to the WEM Rules, to market systems and processes; Did not jeopardise the delivery of the Tranche 2 objective and the overall WEM Reform Program; and

  - Achieve a balance between the timeliness of an interim solution against the broader reforms of the WEM Reform Program (such as reforms to the Ancillary Services framework, the Reserve Capacity Mechanism and market systems) required to support the Tranche 2 solution.

- Assumptions of the assessment:
  - Utility-scale ESS (i.e. is not a Virtual Power Plant or aggregated behind-the-meter implementation), participating in the WEM and providing Ancillary Service(s).
  - Is based on a stand-alone ESS proponent who is considering connecting to the SWIS.
  - The Tranche 1 pathway would be superseded by the Tranche 2 pathway

TECHNICAL RULES

- Initial discussions have occurred between AEMO, PUO and Western Power.
- The current technical rules do not cater for any type of storage
- There is some experience with smaller batteries at the distribution level. Transmission batteries are typically different in purpose and scale.
- Connection of all types of storage would be considered and is encouraged.
- Ideally a range of technology capabilities would be trialled to inform the Technical Rule amendments required.
- Some temporary rule exemptions may be required and potentially obligations to comply with future rule changes for storage. These would be evaluated through the normal connection process.

PROPOSED PATHWAY FOR TRANCHE 1 – WHAT CAN WE DELIVER NOW?

A proposed registration pathway for a stand-alone ESS could be to register as a Scheduled Generator under the current WEM Rule framework.

Key findings of this proposal:

- It is anticipated that this option may only require minimal changes to the WEM Rules.

An ESS proponent could:

- submit a tender response via a contract to AEMO for Spinning Reserve and Load Rejection Reserve Ancillary Services.
- prospectively participate in LFAS subject to further consideration.

This is an interim option, to be superseded by the delivery of the wider reform program which would look to enable ESS proponents to participate to the greatest extent practicable in the WEM.

It may offer engagement and contractual opportunities for ESS proponents who consider the Tranche 1 solution as a viable solution or can offer ideas to enhance the viability of this solution.

OTHER CONSIDERATIONS - LFAS

The availability of Load Following Ancillary Service (LFAS) revenue streams as part of the Tranche 1 solution is probable, however requires further consideration due to the complexities to be considered.

It appears accommodating LFAS within Tranche 1 pathway would not meet the criteria for determining scope of Tranche 1. However, given the importance of LFAS as an economic driver for ESS participation, further exploration is warranted.

LFAS CONSIDERATIONS – FINDINGS TO DATE

There are several design features of the existing LFAS market that have implications for the capability of ESS to participate, these include:

- AEMO considers the existing LFAS gate closures may make ESS participation more challenging, as they would need to commit to LFAS delivery quantities up to 11 hours out. AEMO would require an ESS proponent to satisfy AEMO that they could reliably provide LFAS in light of this limitation to meet the standards required for LFAS Certification.

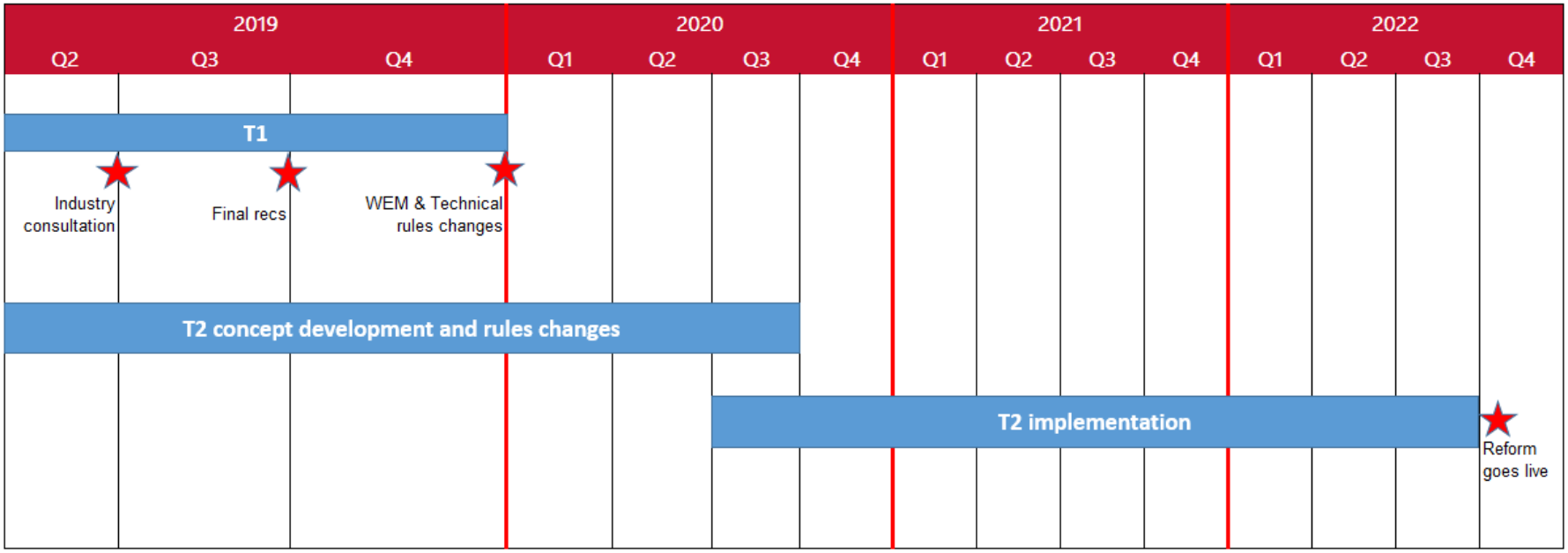
- If an ESS was to participate in LFAS prior to the implementation of the full WEM Reform, further consideration if the participation of ESS in LFAS may increase the risk of undesirable market outcomes that are already evident under the existing framework. These include:
  - Failure by a Facility to provide LFAS will require AEMO to enable backup LFAS at additional cost to the market, but not at any additional cost to the Facility that fails to provide;
  - Ability to bid for single, discrete Trading Intervals of LFAS provision (i.e. one interval on, one interval off). This may require the constant enabling and disabling of other Facilities for LFAS provision, which could raise the total cost of LFAS provision.
  - Consideration of industry feedback as to whether they agree with these consideration factors, and if so if these issues would/could be exacerbated by the participation of ESS in LFAS.

NEXT STEPS

- Publish a paper for stakeholder feedback.
- Produce an Energy Storage Factsheet to be published on AEMO's website outlining information on registering as a Scheduled Market Generator and possible current ancillary services.
- Explore the feasibility of delivering a solution for ESS to provide LFAS.
- Explore the feasibility of changes to the Technical Rules that may be required to enable the connection of batteries
- Explore whether any other changes are needed to enable ESS participation in Tranche 1

Tranche 2: As part of broader WEM Reform, consider and develop participation in all markets and mechanisms for technology types, including for storage.

INDICATIVE TIMEFRAMES



AGENDA ITEM 3

ENERGY SCHEDULING AND DISPATCH

CONSULTANTS

Government of **Western Australia**
Department of **Treasury**

SCED: Energy scheduling and dispatch

MDOWG Meeting 2

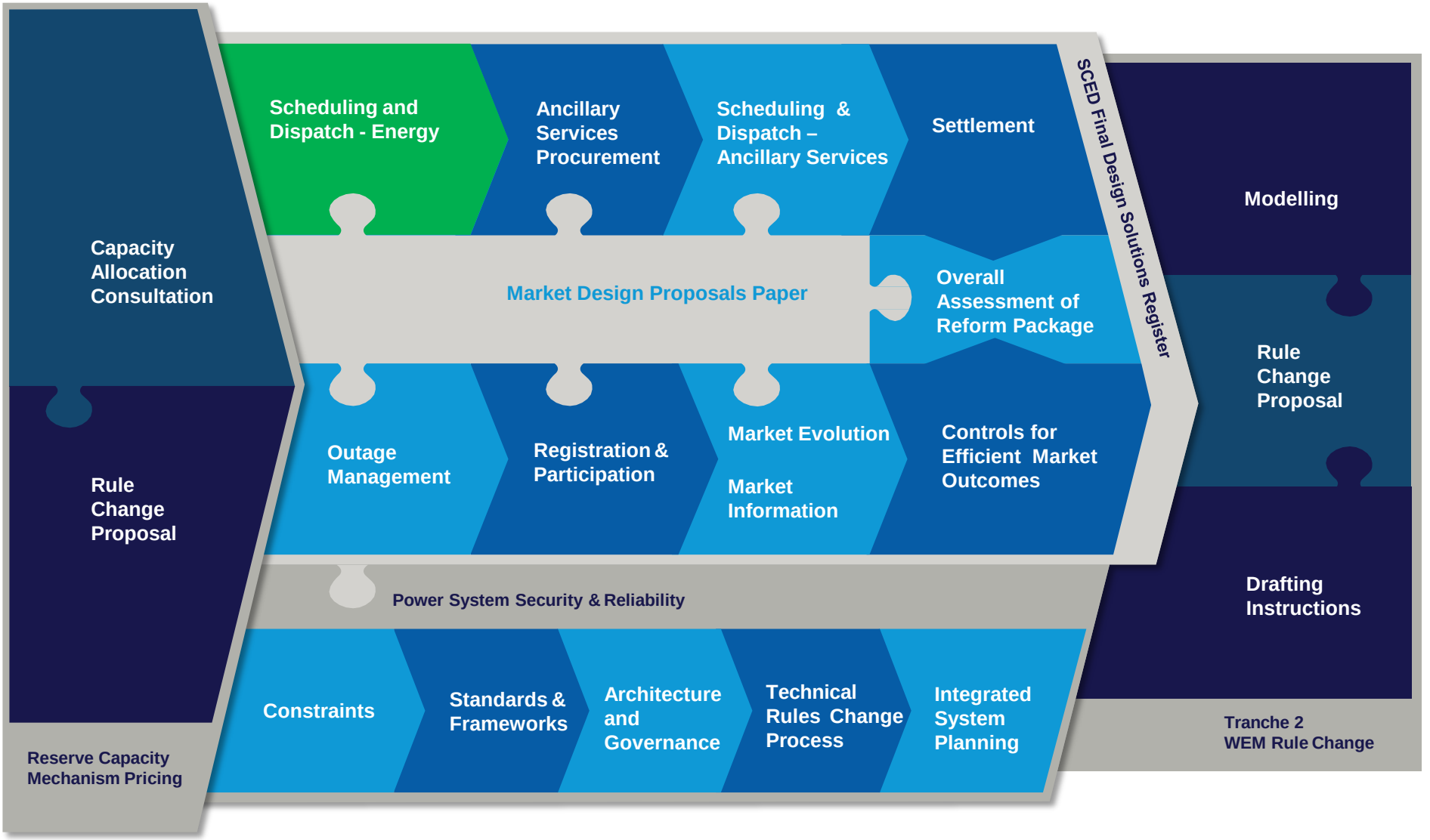
12 March 2019

ENERGY SCHEDULING AND DISPATCH

Overview

- Introduction and ToR review
- Topics covered in this workshop
- Consultation process
- Objectives and principles
- Content

WEM REFORMS - PROVISIONAL



MDOWG TRANCHE 2 SCOPE ITEMS

- Energy scheduling and dispatch
- Ancillary service procurement
- Ancillary service scheduling and dispatch
- Settlement
- Registration and participation
- Controls for efficient market outcomes
- Market evolution
- Market information

CORE DESIGN FEATURES

- Security-constrained economic dispatch
- Individual facility bidding and dispatch
- Co-optimisation of energy and ancillary services

Supported by:

- Reduced gate closure
- 5 min dispatch interval
- Ex ante pricing
- Self commitment

THIS SESSION: ENERGY SCHEDULING & DISPATCH

- Gate closure
- Facility aggregation
- Mandatory offers
- Network model for clearing
- Ramping profiles
- Energy storage dispatch
- Market schedules
- Short-Term Energy Market
- Demand side response

CONSULTATION PROCESS

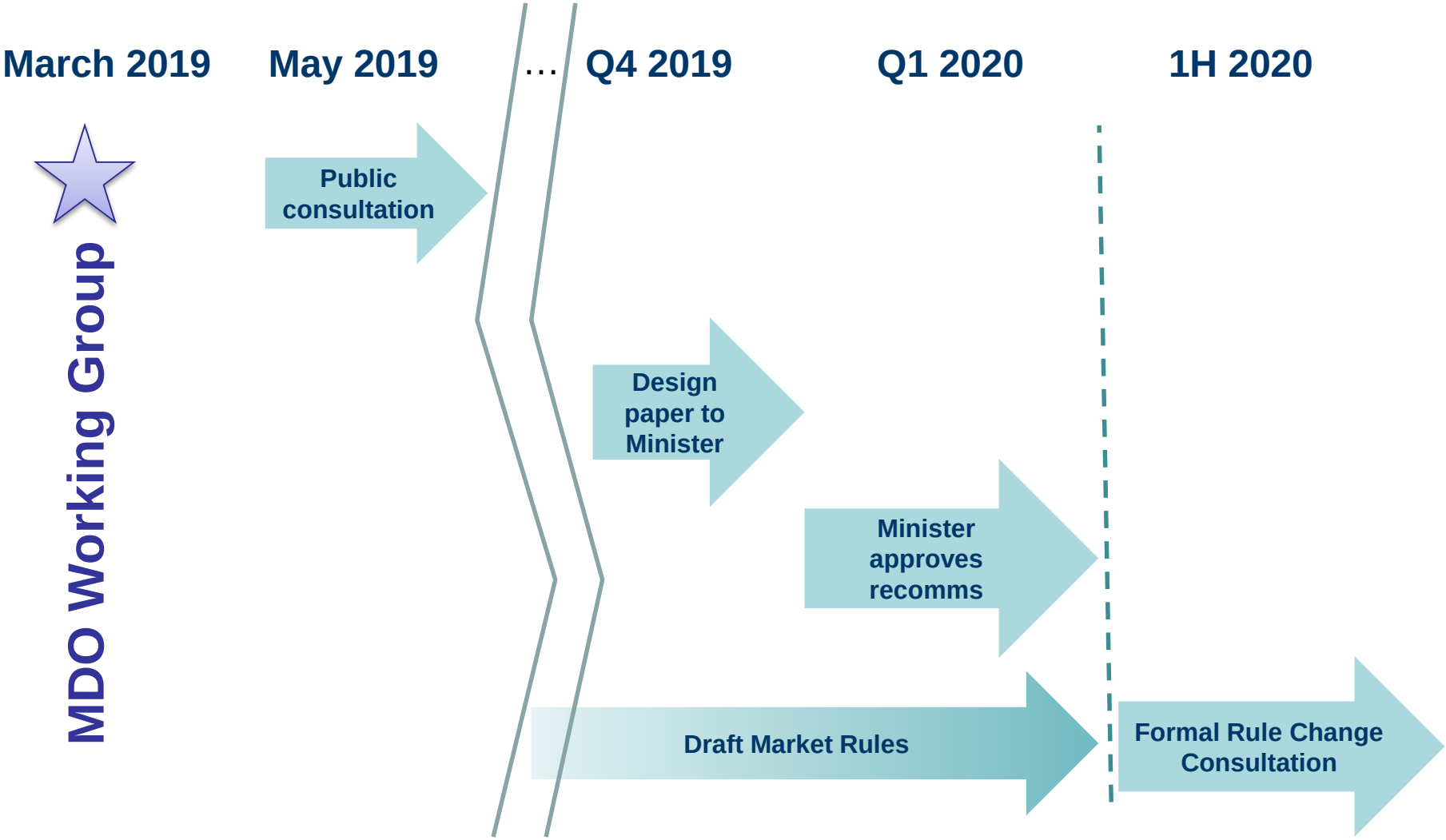
In this session we will explore draft design positions, to inform…

Public consultation paper, with responses incorporated into…

Recommendations to Minister, with approval triggering…

Rule change consultation

CONSULTATION TIMEFRAME



WEM OBJECTIVES

Promote economically efficient, safe and reliable production of electricity in the SWIS

Encourage competition by facilitating efficient entry of new competitors

Avoid discrimination against particular options and technologies

Minimise the long-term cost of electricity supplied to SWIS customers

Encourage measures to manage the amount of electricity used and when it is used.

GUIDING PRINCIPLES

All design features:

- Measured against WEM objectives
- Fit-for-purpose for WEM, learning from best practice approaches in other jurisdictions
- Align control and responsibility for market outcomes to empower entities able to effect an outcome to do so
- Avoid unnecessary cost impost and administrative/regulatory burden (consider practicality of implementation)
- Avoid complexity if no demonstrable benefit
- Improve transparency of information and outcomes

KEY PRINCIPLES FOR REAL-TIME SCHEDULING AND DISPATCH

- Provide good quality information on which market participants can base decisions
- Allow decisions to be made as close to real-time as possible
- Place similar obligations on similar facilities
- Incentivise facilities to make flexibility available
- Allow participants operational flexibility where it does not affect power system security

GATE CLOSURE (1)

Gate closure refers to the cut-off time before which participants can submit revised offers into market processes.

Current state

- AEMO needs time to align unconstrained BMO with network and security constraints, and to translate Synergy portfolio dispatch to facility dispatch
- Participants may not change offer prices or quantities within 120 mins of the start of the trading interval (other than for physical reasons)

Future state

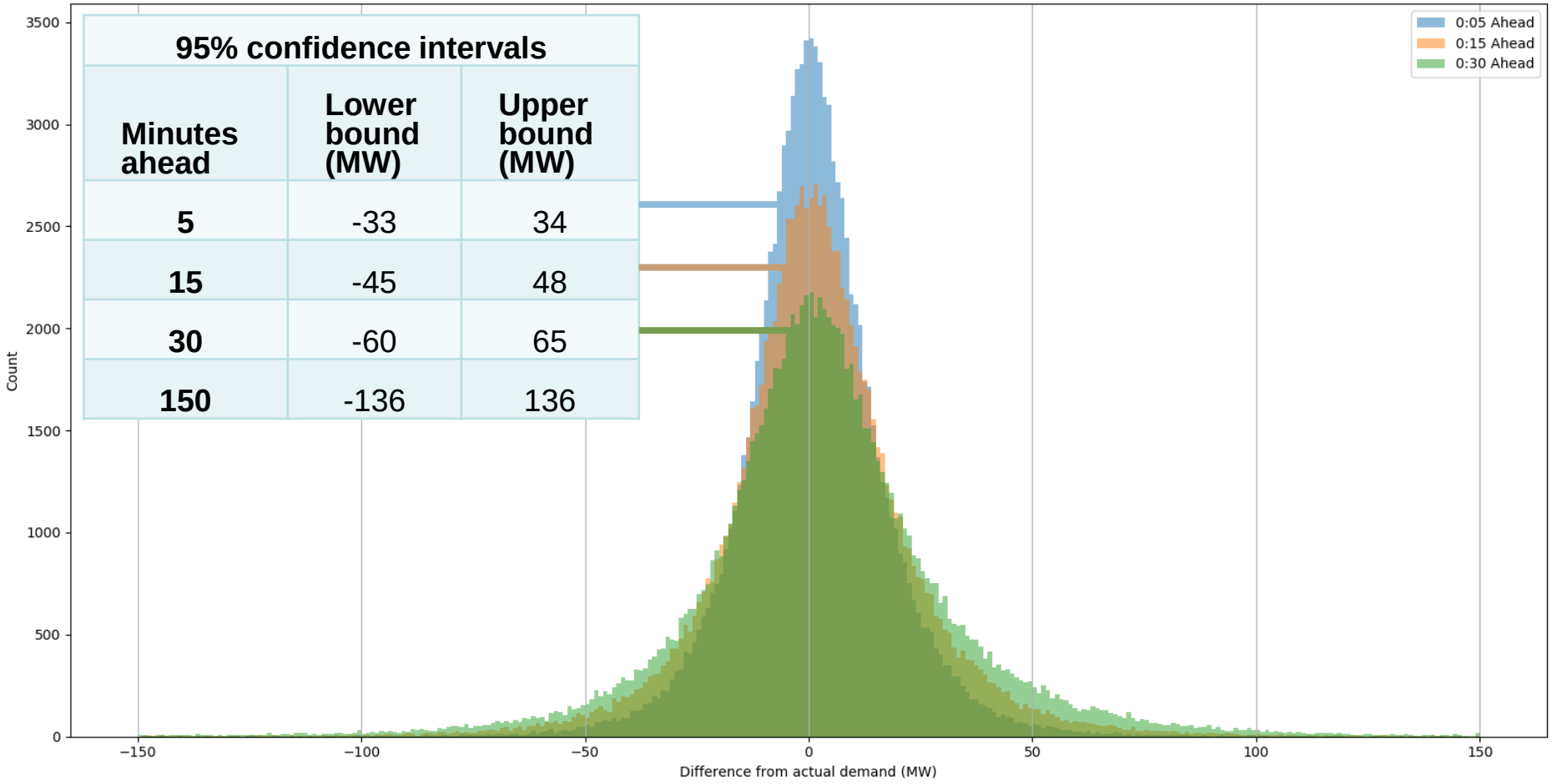
- Network and security constraints incorporated into market clearing
- Synergy facilities individually offered and cleared
- Gate closure can be reduced or eliminated

Potential issues

- Significant last minute offer changes can result in:
  - Different dispatch than signalled in pre-dispatch schedules
  - Sudden change in system conditions, sudden change in prices

GATE CLOSURE (2): FORECAST ACCURACY

95% confidence intervals		
Minutes ahead	**Lower bound (MW)**	**Upper bound (MW)**
5	-33	34
15	-45	48
30	-60	65
150	-136	136



GATE CLOSURE (3)

Dimensions:

1. Time (zero vs 30 minutes)
2. Different closures for prices and quantities
3. Different closures for different participants

Draft proposal:

- Same closure for prices and quantities
- 15 minute soft gate closure at go-live
- Zero gate closure after 6 months unless strong evidence of system insecurity
- Same closure for all participants (incl Synergy)
- Good faith offering provisions with ex-post monitoring and enforcement to review last-minute reoffering behaviour

Cost/benefit contribution:

- Maximises participant flexibility, increasing overall market efficiency
- Earlier return from outage reduces energy costs

FACILITY AGGREGATION (1)

Offer granularity is the level of detail at which information about each facility is made visible to the market clearing engine

Current state

- Synergy offers as a portfolio into market clearing processes
- Some other facilities represent a single generating unit, some represent a number of aggregated generating units
- Ancillary services are cleared separately in advance of energy
- Intermittent generators injecting at a common network connection point must be aggregated. Aggregation of others at AEMO discretion

Future state

- Security constrained dispatch requires facility dispatch for Synergy
- Least-cost dispatch of energy and ancillary services requires them to be co-optimised together

FACILITY AGGREGATION (2)

Considerations:

- Offers must be sufficiently granular to make trade-offs visible to MCE
- Aggregation of large generators would change real-time AS results
- Credible contingency may cover multiple generating units (CCGT)

Draft proposal:

- SCADA visibility and standing data required at generating unit level
- Facility aggregation mandatory where credible contingency is a multiple generating unit outage for reasons other than network connectivity
- Facility aggregation permitted where electrically co-located and AS results are unlikely to be affected (AEMO discretion)
- Potential for “station dispatch”

Cost/benefit contribution:

- Avoid over-procurement of AS
- Participant flexibility increases market efficiency

MANDATORY OFFERS (1)

The reserve capacity mechanism exists to ensure sufficient energy supply at times of system peak. Mandatory offer requirements are a key mechanism to ensure this capacity is available to be dispatched in real-time.

Current state

- Capacity credits are allocated on the basis of sent-out capacity
- Facilities holding capacity credits must offer this capacity into STEM and Balancing
- Balancing Market offers must also 'reflect reasonable expectation of the capability … to be dispatched', obliging all facilities to offer their full capacity regardless of capacity credits
- (Intermittent generators are treated differently)

Future state

- Capacity credits will no longer be directly linked to sent-out capacity, as allocation process considers network constraints

MANDATORY OFFERS (2)

Considerations:

- Any capacity not allocated capacity credits is not needed to meet the planning criterion or maintain power system security
- AEMO need visibility of facility availability in case out-of-market dispatch is required in system emergency

Draft proposal:

- Retain requirement for facilities holding capacity credits to offer that capacity into STEM and real-time market as a minimum
- Capacity not covered by capacity credits not required to offer into STEM or real-time market
- All facilities holding non-zero capacity credits must participate in outage process
- Facilities holding zero capacity credits must inform AEMO of availability/unavailability, but don't participate in full outage process

Cost/benefit contribution:

- Removes uncompensated requirement to offer, increasing flexibility
- Unlikely to affect energy prices compared to offering at cap

NETWORK MODEL FOR CLEARING (1)

Real-time market will retain single system-wide price in each dispatch interval – locational differences dealt with by constrained payments

Network model in the clearing engine is a separate decision. Options:

- Single region hub-and-spoke.

  Simplest, quickest and lowest cost to implement, can leverage existing AEMO systems and knowledge.

- Multi-region hub-and-spoke.

  More complex implementation, longer timeframe, higher cost. Can still leverage existing AEMO systems and knowledge.

- Full high-voltage network (nodal).

  Most complex. Longest timeframe and highest cost to implement. May be able to leverage existing AEMO systems, but not knowledge.

  Not feasible by October 2022.

NETWORK MODEL FOR CLEARING (2) EXPLORING MULTI-REGION

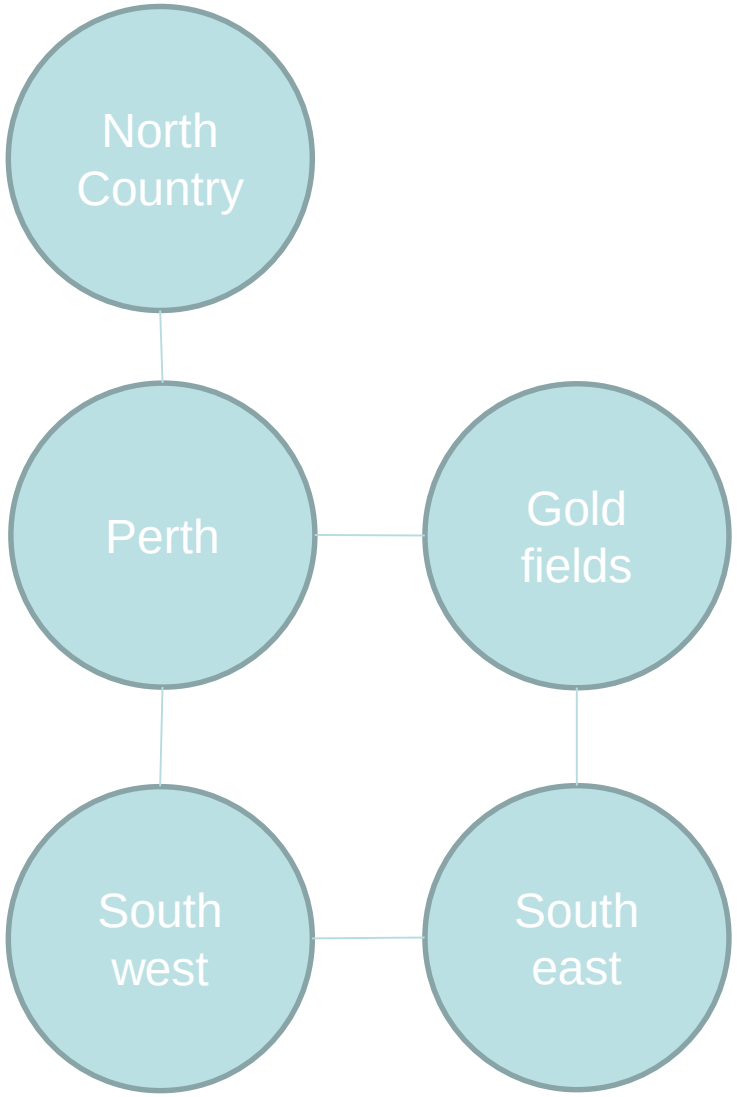
Potential region divisions:

- Align with grid: minimise connections between regions
- Align with market: put expected network constraints between regions

Regional reference nodes:

- Load centre
- Energy flows towards RRN
- Located on other side of likely intra-region congestion from generation

Difficult to draw boundary between Perth and Southwest, other regions are electrically small, still have intra-region congestion.



NETWORK MODEL FOR CLEARING (3)

Increased granularity has theoretical benefits:

- More accurate modelling of network constraints = more efficient dispatch, fewer interventions
- Actual network losses between regions instead of static loss factors = lower settlement residues
- More specific intra-region congestion information = better investment decisions

But is more complex to implement:

- Region and RRN definition is difficult and uncertain
- Development of constraint library for each region would start anew, not use existing Western Power work
- More complex capacity allocation methodology
- More complex data structures, interfaces and data manipulation for settlement

NETWORK MODEL FOR CLEARING (4)

Both models provide:

- improved information to support network planning
- ‘pseudo-nodal’ prices to inform need for future market evolution to more granular pricing

NEMDE engine can support single-region, multi-region and (probably) nodal clearing, meaning possible future market evolution is not blocked by choice of clearing engine or clearing model.

Draft proposal:

- Clearing model uses single-region hub-and-spoke network model
- Use ‘pseudo-nodal prices’ to inform need for future market evolution to more granular clearing and pricing

Cost/benefit contribution:

- Reduced cost of implementation, reduced risk of delay in other benefits

RAMPING PROFILES (1)

Ramping is changing from one output level to another.

Ramp rate is the rate of change in instantaneous output.

Ramping profile is the shape of the time series between two points in time.

Current state

- Market processes assume that a facility moves to a new output level at its maximum ramp rate
- Most generator ramping occurs in the first part of the trading interval
- Generator ramping profiles do not match the load profile
- The mismatch is managed using load following ancillary service

Future state

- A 5 minute dispatch interval will reduce the length of time AS is needed to compensate for any mismatch in ramping profile
- New facilities are likely to have faster ramping capability than existing facilities

RAMPING PROFILES (2)

Considerations:

- For some facilities, ramp capabilities are embedded in control systems
- Interaction with AS requirements
- Form of dispatch instructions
- Control system capability for non-integer ramp rates
- Use of AGC to implement

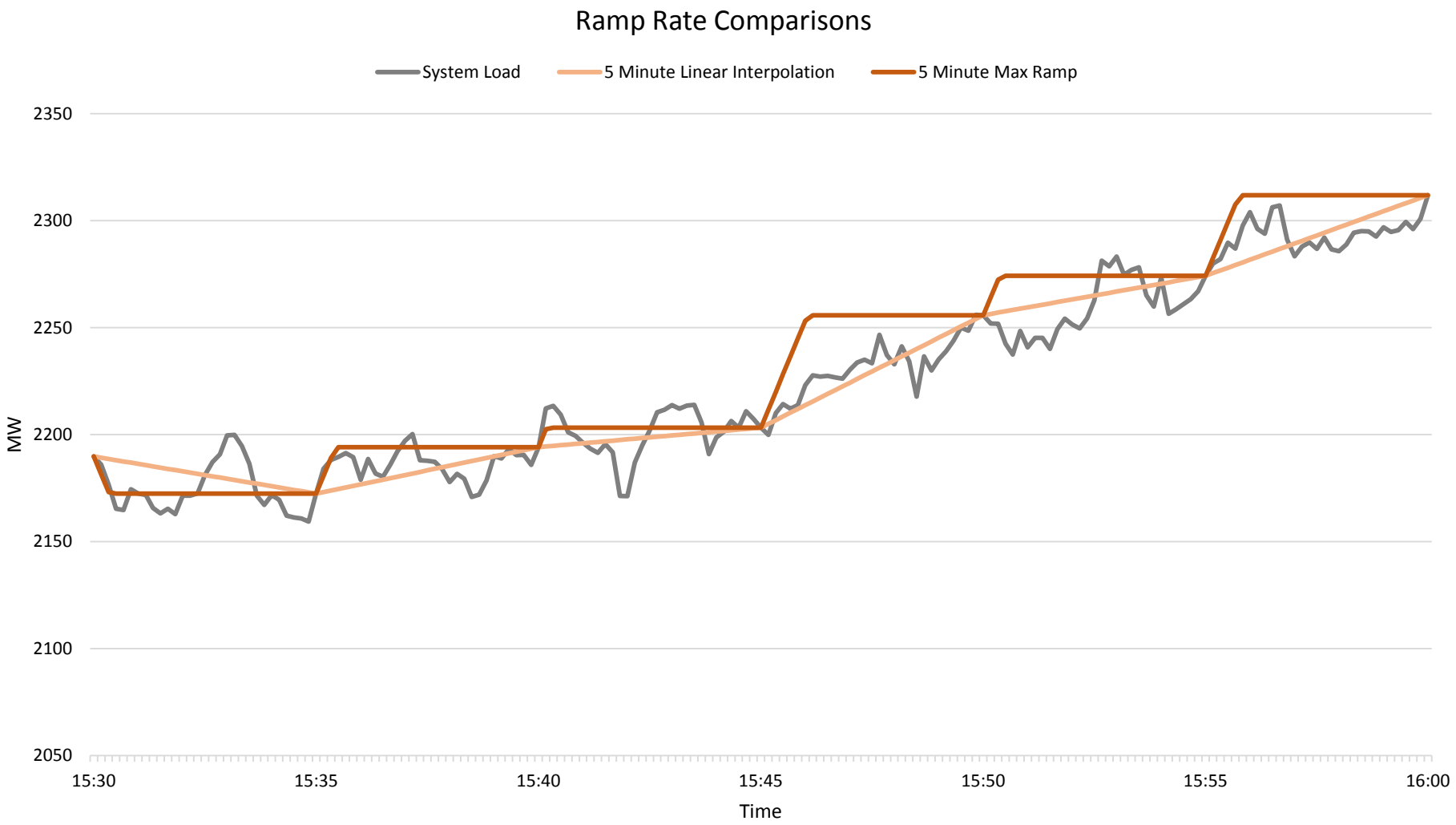
Draft proposal

- Adopt linear ramping profile subject to implementation constraints

Cost/benefit contribution:

- Reduction in quantity of load-following service required ($100k - $500k/MW/yr)
- Costs to change facility control systems

RAMPING PROFILES (3): EXAMPLE



ENERGY STORAGE DISPATCH (1)

Current state

- WEM registration framework does not consider energy storage, and does not enable its full participation
- AEMO and PUO are assessing feasibility and value of interim participation pre-2022

Future state

- Increasing penetration of battery storage, both grid-connected and distributed
- Ancillary services likely to be first wholesale use case, capacity optimisation and wholesale energy price arbitrage secondary
- Extremely flexible response can offset increasing intermittent generation
- Market must allow maximum participation of these flexible resources

ENERGY STORAGE DISPATCH (2)

Considerations:

- Dispatch of injection only, or both injection and withdrawal
- Capability limitations (charge status)
- Intertemporal optimisation

Draft proposal

- Central dispatch of both injection and withdrawal
- Intertemporal considerations left to participants (self-commitment)
- AEMO has visibility of charge status in case of system emergency

Cost/benefit contribution:

- Enable participation in AS provision potentially driving down costs
- Energy shifting lowers overall energy supply cost

MARKET SCHEDULES (1)

Market schedules signal forecast market outcomes at regular intervals ahead of real-time, allowing participants to respond

Current state

- Unconstrained dispatch means information for participants is published in multiple sources
  - Forecast BMO generated every 30 minutes based on a single load/intermittent generation forecast
  - Network and security information provided in dispatch advisories (and signalled in longer-term Ancillary Service publications)
  - Separate dispatch plan for Synergy
  - PASA and real-time outages

Future state

- Offers, network and security constraints incorporated into clearing engine, giving option for integrated predispatch schedule
- Potential for contextual information: constraints, sensitivity scenarios

MARKET SCHEDULES (2)

Dimensions:

- Horizon, resolution and frequency
- Information required
- Information provided
- Sensitivity schedules

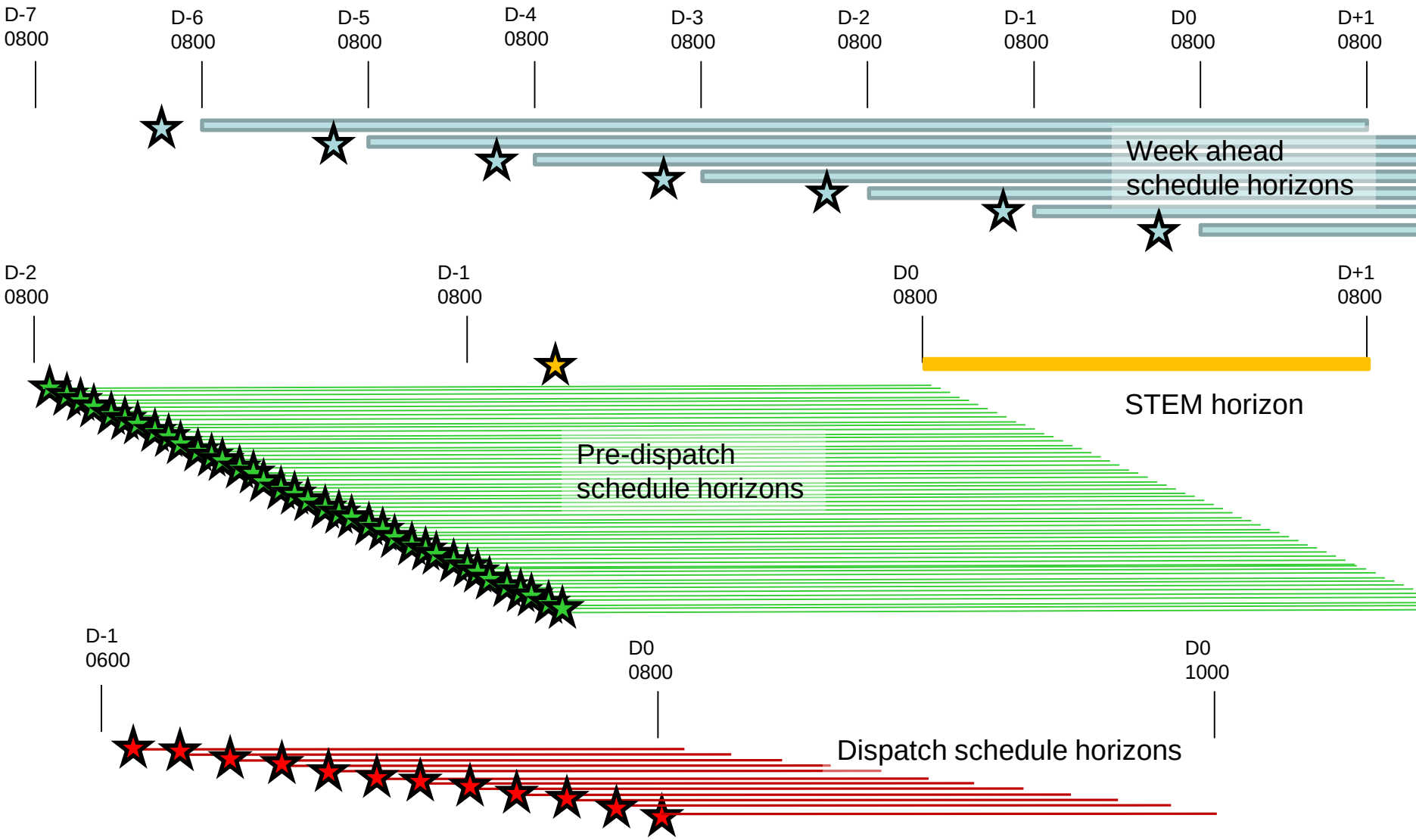
Draft proposal

- Week ahead, 30 minute resolution, updated daily
- Two days ahead, 30 minute resolution, updated half-hourly
- Two hours ahead, 5 minute resolution, updated every 5 minutes
- Dispatch data made public, but offer prices not shown
- Full offer and bid data published D+1
- Sensitivity scenarios (eg 10%/90% POE demand/intermittent generation forecasts, critical network outages) published with two-day schedule

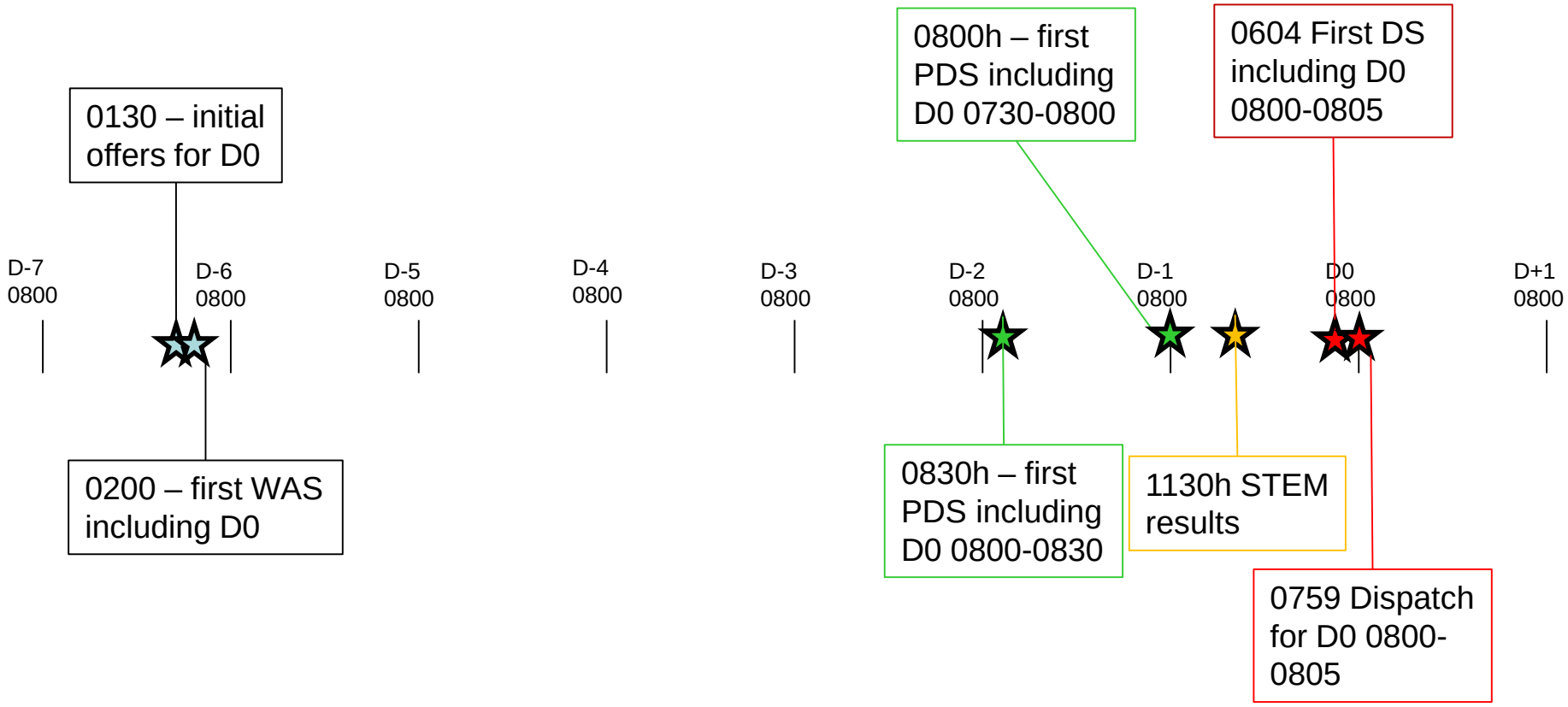
Cost/benefit contribution:

- Better information on upcoming market conditions increases market efficiency

MARKET SCHEDULE TIMELINES



MARKET SCHEDULE TIMELINES



SHORT-TERM ENERGY MARKET (1)

A binding day-ahead market provides a further hedge opportunity for participants, and provides a financial basis for commitment decisions for long-start-time facilities.

Current state

- STEM provides a central, transparent venue for short term (day ahead) hedging for independent retailers on a portfolio basis
- Participants holding CCs obliged to offer that capacity into STEM
- STEM clears on a unconstrained, portfolio basis

Future state

- STEM will be retained on current unconstrained basis
- Constrained dispatch in real-time introduces risk for long-term contracts and existing STEM
- Pre-dispatch schedule provides better data in advance of STEM

SHORT-TERM ENERGY MARKET (2)

Considerations:

- Changes to AEMO provided data
- Mandatory offer obligations (as above)
- Exposure to volume risk if constraints affect dispatch
- Requirement to offer at SRMC (market power)

Draft proposal:

- Pre-dispatch schedule replaces some AEMO data provision, including projected AS quantities and load forecast
- Retain obligation to offer CC volumes
- Participants can manage expectation of real-time constraint through offer prices
- Consider SRMC offer requirements as part of overall market power mitigation package
- Potential to move STEM window later in the day

Cost/benefit contribution:

- Limited change
- Better information on upcoming market conditions increases market efficiency

DEMAND SIDE RESPONSE (1)

Demand side response is controllable variation in consumption (either from load control, or from behind-the-fence generation or storage)

Current state

- Demand side programme construct provides system-wide demand reduction, and is dispatched as last resort with long lead time
- DSP may comprise loads from anywhere on the network
- Intermittent loads with behind-the-fence generation can be dispatched in a restricted way
- Interruptible load provides spinning reserve service via contract

Future state

- Last resort system-wide load reduction service likely to still be useful
- Some demand side participants can provide very flexible response
- Security constrained real-time dispatch requires clarity of location
- AS co-optimisation means DSR cleared along with generation

DEMAND SIDE RESPONSE (2)

Considerations:

- Intermittent load could use same offer and dispatch mechanisms as storage, and for equity should be subject to the same consumption scheduling
- Compensation mechanism – supply offers or demand bids

Draft proposal:

- DSR participates in real-time market via consumption bids instead of separate merit order, but may require longer dispatch lead time
- No location restrictions when aggregating DSR for last-resort energy, but DSR not offering at the cap must be electrically co-located
- Remove option for geographic separation of intermittent load

Feedback requested:

- Appetite for scheduled load other than facilities holding CCs?
- Appetite for generators associated with intermittent loads to be dispatched below the ‘zero’ point?

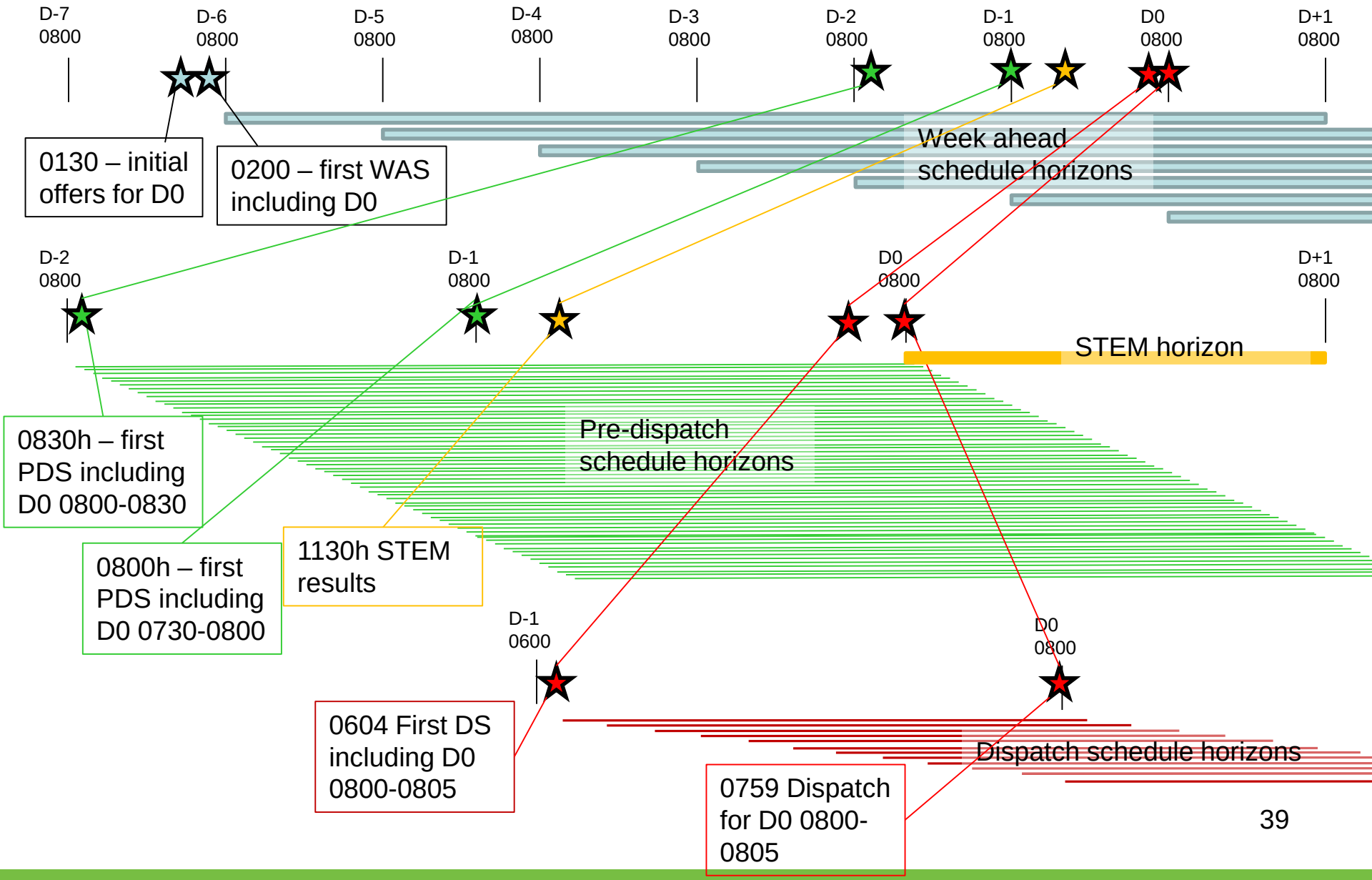
NEXT STEPS

Firm up and further explore matters discussed today

Release consultation paper setting out design proposals and seeking public comment

Thank you

MARKET SCHEDULE TIMELINES



RAMPING PROFILES (4)
ACTUAL LOAD LESS RAMP PROFILE

	0.1% (MW)	99.9% (MW)
Max	-39	+40
Linear	-35	+31